

## **PHY6645, Applied Quantum Mechanics (Spring 2023)**

**Instructor:** Dr. Inna Ponomareva; Office: ISA 5103; E-mail: [iponomar@usf.edu](mailto:iponomar@usf.edu); telephone: 974-7286

Text: Quantum Mechanics v2, 2<sup>nd</sup> ed; Publisher: Wiley; Authors: Claude Cohen-Tannoudji, Bernard Diu, Franck Laloë ([available online through USF library, perhaps with some restrictions](#)), Applied Quantum Mechanics, 2<sup>nd</sup> ed; Publisher Cambridge; Author: A.F. Levi ([available online through USF library, perhaps with some restrictions](#))

Class: MW 9:30am-10:45am ISA 4010

Office Hours: T 9:30-10:30am, F 9:00-10:00 am and by appointment.

### **Course Outline and Objectives**

The course targets applications of fundamental principles of quantum mechanics and will lay foundation for exploring ideas in quantum entanglement, phases of matter, information, and effects. The focus on electron spin, angular momenta, perturbation theory, methods for time-dependent problems, systems of identical particles, quantum entanglement. Some specific applications will include electron transistor, resonant tunneling, energy bands, density of states, "no cloning" concept, stimulated optical transitions, semiconductor laser, hybridization. The main ideas are understood and re-enforced by developing conceptual knowledge and problem-solving skills. The course is best suited for students who already took a foundational Quantum Mechanics course. Problems will be assigned from each chapter of the text. In addition, conceptual questions will be offered. Up to two randomly chosen problems from the homework may be graded. The homework will be due at the beginning of the first lecture of the next chapter. In addition, there will be a quiz after each chapter that emphasizes basic concepts of the material learned. I will give exact dates for these quizzes about one week in advance. In studying for the quizzes and examinations you are encouraged to work on problems in the book in addition to those assigned. Please read the text before each lecture. Although I will not require attendance, it is paramount that you come to every lecture in order to keep up with the work. Please come see me during office hours if you have missed a lecture to get 'up to speed' on the course work.

|                                |                   |      |
|--------------------------------|-------------------|------|
| <b>Course Grading Breakout</b> | Homework Problems | 20 % |
|                                | Quizzes           | 20 % |
|                                | Mid-term Exam     | 30 % |
|                                | Final             | 30 % |

**Course Grading:** each problem/question will be graded on a scale 0-4, and the average grade for the assignment will be computed. More specifically,

- 0 the concept comprehension/skill has not been demonstrated or attempt at solution is not sound
- 1 the problem solved or question answered about 25%
- 2 the problem is half solved or question is half answered
- 3 the problem solved or question answered about 75%
- 4 the problem is fully solved or question is fully answered

The GPA-inspired scale will be used to assign final letter grade for the course:

|              |              |
|--------------|--------------|
| 3.7 – 4.0 A  | 1.7 – 1.9 C  |
| 3.3 – 3.6 A- | 1.3 – 1.6 C- |
| 3.0 – 3.2 B+ | 1.0 – 1.2 D+ |
| 2.7 – 2.9 B  | 0.7 – 0.9 D  |
| 2.3 – 2.6 B- | 0.3 – 0.6 D- |
| 2.0 – 2.2 C+ | 0.0 – 0.2 F  |

## **Tentative Schedule and Examination Dates**

| <b>Week Beginning</b> | <b>Topics (Chapters in Text)</b>                                                                            |
|-----------------------|-------------------------------------------------------------------------------------------------------------|
| Jan 8                 | Electron spin (IX + complements)                                                                            |
| Jan 15                | Addition of angular momenta (X +complements)                                                                |
| Jan 22                |                                                                                                             |
| Jan 29                | Stationary perturbation theory (XI+complements)                                                             |
| Feb 5                 |                                                                                                             |
| Feb 12                | An application of perturbation theory (XII+complements)                                                     |
| Feb 19                | Approximation methods for time-dependent problems (XIII+complements)                                        |
| Feb 26                | Mid-term on Chapters IX-XIII + Ch. XIII, Quiz on March 1,                                                   |
| Mar 5                 | Systems of identical particles (XIV+complements)                                                            |
| Mar 12                | Spring Break                                                                                                |
| Mar 19                |                                                                                                             |
| Mar 26                | Applications: Electron propagation (Levi, Chapters 3-4)                                                     |
| Apr 2                 |                                                                                                             |
| Apr 9                 | Applications of eigenstates and operators (Levi, Chapter 5)                                                 |
| Apr 16                | Applications of theory of indistinguishable particles (Levi, Chapter 7)                                     |
| Apr 23                | Applications of time-dependent perturbations (Levi, Chapter 8)                                              |
| Apr 30                | FINAL on Chapter XIV, Chapters 3-4,5,7-9 of Levi text + Levi, Chapter 8 Quiz on Wednesday May 3 (tentative) |

## **NOTES**

Students who anticipate being absent from exams due to a major religious observance must provide notice of the date(s) and event(s) to the instructor, in writing, by the second class meeting. Notes and Tapes are not permitted for purposes of sale.

Any student with a disability is encouraged to meet with me privately during the first week of class to discuss accommodations. Each student must bring a current Memorandum of Accommodations from the Office of Student Disability Services (974-4309, SVC1133) which is prerequisite for receiving accommodations. Accommodated examinations through the Office of Student Disability Services require at least two weeks notice.

USF has a set of central policies related to student recording class sessions, academic integrity and grievances, student accessibility services, academic disruption, religious observances, academic continuity, food insecurity, and sexual harassment that apply to all

courses at USF. Be sure to review these online: [usf.edu/provost/faculty-success/resources-policies-forms/core-syllabus-policy-statements.aspx](https://usf.edu/provost/faculty-success/resources-policies-forms/core-syllabus-policy-statements.aspx)

### **COVID NOTE**

If class is to be moved on-line due to COVID we will continue meeting during the regular class times via zoom or other software. Webcamera, microphone, computer and internet are required for that. For examinations we will use on-line proctoring (honorlock).